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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 112. HDU-13/M--ETC(U).
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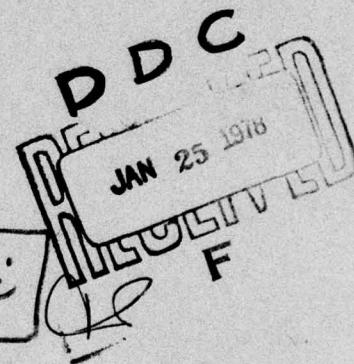
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⑯ **USAF BIOENVIRONMENTAL NOISE DATA
HANDBOOK.**

Volume 112.

**HDU-13/M Heater, Explosion Proof,
Duct Type, Portable.**



⑰ Technical rept., ⑯ Nick A. Farinacci

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AEROSPACE MEDICAL RESEARCH LABORATORY
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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

H. E. von Gierke
HENNING E. VON GIERKE
Director
Biodynamics and Bionics Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The HDU-13/M Heater is an explosion-proof, electric motor-driven, portable ground heater designed to provide heat and ventilating output while operating in an explosive atmosphere such as encountered in the purging of aircraft fuel tanks. This report provides measured data defining the bioacoustic environments produced by this unit operating inside a large aircraft hanger at normal rated conditions. Near-field data are reported for 37 locations in a wide variety of physical and psychoacoustic measures: overall and band sound		

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pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, 'USAF Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application', AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723104, Measurement and Prediction of Noise Environments of Air Force Operations.

The author acknowledges the efforts of Mr. Robert T. England and Mr. Robert G. Powell who conducted the field measurements, and Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report. Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton assisted in the mechanics of data processing, and Mrs. Norma Peachey typed and prepared the graphics.

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NEAR-FIELD NOISE

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INTRODUCTION

The HDU-13/M Heater is an explosion-proof, electric motor-driven portable ground heater designed to provide heat and ventilating output while operating in an explosive atmosphere such as encountered in the purging of aircraft fuel tanks. This unit is manufactured by the American Air Filter Company, Inc.

This volume provides measured data defining the bioacoustic environments produced by this unit. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the HDU-13/M heater.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15C temperature, 70% rel humidity, 0.760 meters Hg barometric pressure) to derive comparable data for other meteorological conditions. Refer to Volumes 1 and 2 (references 1 and 2) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.
2. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise*, AMRL-TR-75-50 (2), AMRL, WPAFB, OH, 1975.

NEAR-FIELD NOISE

MEASUREMENTS

A standard HDU-13/M Heater was operated inside, and approximately in the center of a large aircraft hanger (167.6 m 36.5 m wide \times 18.3 m high) on a concrete floor at a normal rated condition of 3500 RPM. The hanger walls and ceiling were not acoustically treated. No aircraft were in the vicinity of the unit while being measured. No far-field acoustic data were acquired because of the relatively close proximity of the hanger walls.

Figure 1 identifies 36 noise measurement locations at a height of 1.5 meters above the concrete apron (nominal ear level of ground crew). The 0 degree reference direction passes through the tow bar. These locations are in the acoustic near-field of the source where the sound wave fronts generally do not spherically diverge and the source appears to be spatially distributed (i.e., not a point source). Consequently, these near-field data cannot be extrapolated to longer distances but do properly define the levels at locations close to the unit.

Near-field measurements were also made at ear level at the operator control panel. Table 1 lists the numeric/alphabetic designators used on the data pages in this report to identify the operator measurement location and test conditions. The designator 1/A means operator location 1 and test condition A. Such a descriptor is essential in many handbook volumes that involve multiple combinations of locations/conditions. It is used in this report to maintain format consistency.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced by the HDU-13/M unit at the 37 specified, near-field locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data one can calculate the variety of measures in Table 3 which are widely used to assess the effects of noise on personnel and their performance.

For data at other intermediate near-field locations (i.e., for radial distances less than 4 meters) you can interpolate between the 36 measured data points.

TABLE 1
MEASUREMENT LOCATION AND TEST CONDITION
FOR OPERATOR NOISE MEASUREMENTS

HDU-13/M Heater, Explosion Proof, Duct Type, Portable
Wright Patterson AFB, 2 Nov 1972
FSN 4520-817-1793

Measurement Location

1

Operator Control Panel

Operation

A

3500 RPM

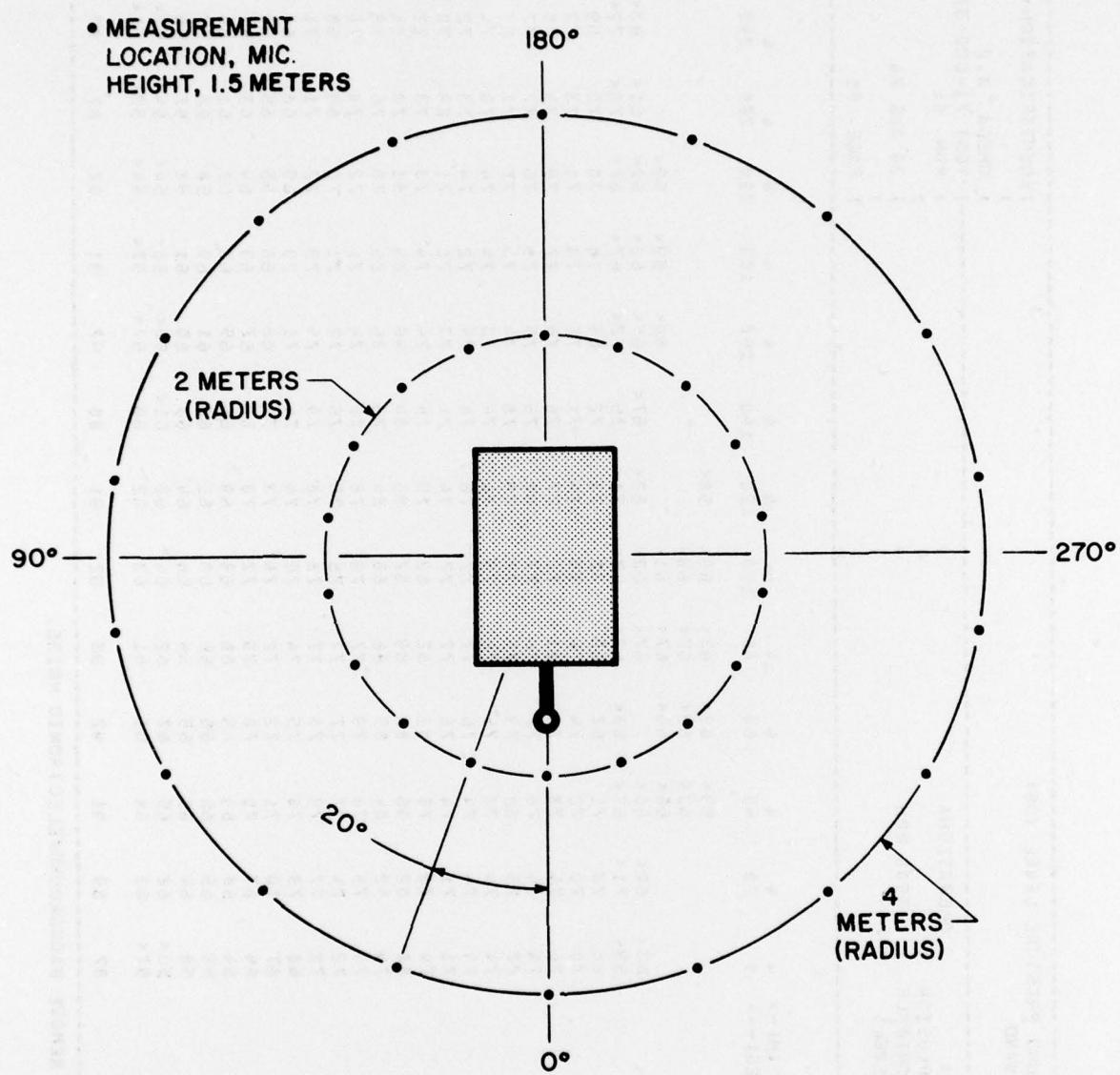


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)

2

NOISE SOURCE/SUBJECT: HDU-13/M HEATER-EXPLOSION
PROOF, DUCT TYPE PORTABLE
NEAR FIELD NOISE LEVELS
(INSIDE HANGER)

FREQ (HZ)	DISTANCE (M) -->	ANGLE (DEG) -->	OPERATION:												
			0	20	40	60	80	100	120	140	160	180	200	220	240
25	59<	62<	68<	59<	58<										
31.5	63<	62<	60<	63<	67<	60<									
40	66<	65<	67<	63<	67<	61<									
50	69<	71<	67<	67<	67<	62<									
63	68	73	71	67	68	70	73	72	75	72<	65<	62<	60<	61<	63<
80	70	70	72	74	75	74	74	71	72	72	73	71	70	70<	72<
100	76	74	73	79	81	78	77	76	76	76	77	75	79	78	78
125	74	76	78	77	78	77	77	80	75	75	76	77	77	77	77
160	77	75	80	79	75	77	79	78	74	74	76	77	77	77	77
200	74	74	73	76	75	75	74	74	73	73	74	74	75	74	74
250	74	74	74	76	77	77	76	76	74	74	72	74	73	72	72
315	71	71	74	76	77	77	77	74	74	74	72	74	72	73	72
400	74	73	76	82	82	82	82	75	75	74	74	73	73	72	72
500	81	82	86	86	89	87	85	80	90	89	81	79	81	81	81
630	78	82	84	85	86	85	84	79	86	85	78	76	76	76	76
800	73	79	78	79	77	77	79	78	76	76	74	71	72	70	70
1000	72	74	77	77	77	77	76	76	76	76	72	71	70	69	68
1250	72	77	79	78	77	78	78	78	79	79	75	73	72	71	71
1600	68	73	74	75	74	76	74	74	74	71	70	69	68	67	67
2000	67	70	71	72	74	72	74	73	71	68	65	65	65	63	63
2500	64	67	67	70	70	70	72	70	67	67	65	64	63	61	61
3150	64	68	69	69	68	69	68	69	66	65	63	62	61	60	60
4000	59	65	66	66	66	66	66	65	63	61	60	58	57	56	57
5000	58	64	65	64	65	64	66	64	63	60	58	57	56	56	56
6300	56<	62	65	63	62	64	62	62	61<	58<	58<	54<	54<	52<	52<
8000	57<	63	64	61	61	63	62	60	57<	57<	54<	53<	51<	51<	51<
10000															
OVERALL	87	89	91	92	93	92	91	88	92	91	87	87	87	87	87

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE I MEASURED SOUND PRESSURE LEVEL (DB)
2 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT:		OPERATION:		IDENTIFICATION:									
HDU-13/M HEATER-EXPLOSION PROOF, DUCT TYPE PORTABLE NEAR FIELD NOISE LEVELS (INSIDE HANGER)				TEST 71-020-370 RUN 02		OMEGA 3.2							
				20 AUG 74									
				PAGE F2									
FREQ (HZ)	ANGLE (DEG) ->	4	4	4	4	2	2	2	2	2	2	2	2
		260	280	300	320	340	0	20	40	60	80	100	120
25							58<	59<	60<	61<	62<	63<	64<
31.5							60<	61<	61<	61<	60<	60<	61<
40							61<	61<	61<	61<	60<	60<	61<
50							62<	63<	63<	64<	64<	65<	64<
63							64<	65<	65<	67<	69<	70<	70<
80							72<	73	70<	71<	74	75	76
100							70	72	69	68	73	70	70
125							71	72	71	72	72	72	71
160							76	74	75	76	76	76	76
200							76	77	77	78	78	78	78
250							75	75	73	72	72	72	72
315							73	74	75	72	80	82	82
400							68	71	70	71	71	73	73
500							72	73	73	76	77	79	76
630							80	79	83	82	91	95	98
800							77	76	79	74	77	86	91
1000							69	70	70	71	73	79	83
1250							68	68	69	70	72	73	74
1600							69	71	71	72	73	80	83
2000							67	67	68	67	66	73	77
2500							63	63	65	65	66	69	76
3150							61	61	63	63	63	66	73
4000							60	60	61	61	62	65	72
5000							57	57	58	58	59	63	71
6300							55	56	56	58	60	61	67
8000							52<	54<	56<	55<	55<	59<	66
10000							51<	51<	52<	55<	55<	59	66
OVERALL		86	86	87	85	87	88	94	96	98	100	102	101

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE 2
MEASURED SOUND PRESSURE LEVEL (DB)
1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT		OPERATION		IDENTIFICATION	
HOU-13/M HEATER-EXPLOSION PROOF, DUCT TYPE PORTABLE		3500 RPM		OMEGA 3-2 TEST 71-020-370	
NEAR FIELD NOISE LEVELS (INSIDE HANGER)		RUN 03		20 AUG 74	
		PAGE F3			
FREQ (HZ)	DISTANCE (M) ->	2	2	2	2
ANGLE (DEG) -->	160	180	200	220	240
				260	280
				300	320
				340	360
				OPERATOR LOCATION	TEST CONDITION
				1/A	1/A
25	61<	59<	59<	65<	61<
31.5	64<	64<	63<	62<	68<
40	67<	66<	66<	67<	74
50	72<	72<	74	71	72
63	74	74	73	76	77
80	73	73	74	77	73
100	77	77	77	77	75
125	78	80	83	82	82
160	80	80	78	78	76
200	80	82	82	79	77
250	81	80	79	77	80
315	80	79	79	76	75
400	74	73	73	72	72
500	74	76	74	73	73
630	90	91	90	80	79
800	86	86	86	78	75
1000	76	74	75	72	71
1250	76	75	74	73	72
1600	76	76	74	73	73
2000	74	74	71	69	67
2500	70	70	69	66	64
3150	68	68	68	65	62
4000	66	65	65	63	61
5000	62	62	61	59	58
6300	62	63	61	57	56
8000	59<	59<	58<	54<	53<
10000	59	59	57<	54<	53<
OVERALL	93	94	93	89	89
				87	87
				88	90
				101	

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE I MEASURED SOUND PRESSURE LEVEL (dB) OCTAVE BAND

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)									
2 OCTAVE BAND									
NOISE SOURCE/SUBJECT: HDU-13/M HEATER-EXPLOSION PROOF, DUCT TYPE PORTABLE NEAR FIELD NOISE LEVELS (INSIDE HANGER)									
OPERATION:									
3500 RPM							20 AUG 74		
							PAGE J1		
FREQ (HZ)	ANGLE (DEG) -->	4	4	4	4	4	4	4	4
	0	20	40	60	80	100	120	140	160
31.5		68	69	72	65				
63		72	75	73	72	75	77	74	72
125		79	78	80	82	83	81	82	79
250		80	79	82	82	81	81	82	80
500		82	83	87	88	90	88	86	85
1000		80	84	86	86	87	86	85	80
2000		74	79	81	80	80	81	77	75
4000		68	71	73	73	73	74	73	70
8000		62	68	69	68	67	69	66	63
OVERALL		87	89	91	92	93	92	91	88

TABLE I MEASURED SOUND PRESSURE LEVEL (dB)
OCTAVE BAND

EN

NOISE SOURCE/SUBJECT:	OPERATION!
HDU-13/M HEATER-EXPLOSION PROOF, DUCT TYPE PORTABLE NEAR FIELD NOISE LEVELS (INSIDE HANGER)	3500 RPM

10

TABLE : MEASURED SOUND PRESSURE LEVEL (DB)

2

IDENTIFICATION:

OMEGA 3.2
TEST 71-020-370
RUN 03
20 AUG 74
PAGE J3

NOISE SOURCE/SUBJECT: OPERATION:

MDU-137M HEATER-EXPLOSION
PROOF, DUCT TYPE PORTABLE
NEAR FIELD NOISE LEVELS
(INSIDE HANGER)

FREQ (HZ)	DISTANCE (M) -->	2			2			2			2		
		160	180	200	220	240	260	280	300	320	340	TEST CONDITION	1/A
31.5		65	65	64	77	78	81	79	78	76	75		72
63		76	76	77	77	78	81	79	78	76	75		80
125		81	83	83	85	85	84	81	79	80	81		89
250		85	85	85	84	82	81	81	82	82	83		90
500		90	91	90	81	81	80	79	81	83	87		98
1000		87	87	86	86	79	78	78	79	79	83		94
2000		78	79	76	75	73	73	73	73	75	75		85
4000		71	71	70	68	65	65	65	66	66	66		78
8000		65	65	63	62	60	59	60	61	61	62		73
OVERALL		93	94	93	89	89	89	89	87	87	86	90	101

TABLE I MEASURES OF HUMAN NOISE EXPOSURE

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE 1 MEASURES OF HUMAN NOISE EXPOSURE
3

HAZARD/PROTECTION										IDENTIFICATION	
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)										TEST 71-020-370 RUN 02 20 AUG 74 PAGE H2	
NO PROTECTION	4	4	4	4	4	2	2	2	2	2	2
DISTANCE (M) ->	260	300	320	340	0	20	40	60	80	100	120
ANGLE (DEG) ->											140
OASLC	86	86	87	85	87	88	94	98	100	102	101
OASLA	82	82	84	81	84	84	92	96	98	100	99
T	679	679	480	407	480	480	120	60	42	30	36
MINIMUM QPL EAR MUFFS	62	63	63	61	63	64	69	72	75	77	75
OASLA*	T	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS	T	57	58	58	56	57	60	63	66	69	70
OASLA*	T	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS	T	59	59	61	57	61	60	69	72	75	77
OASLA*	T	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS	T	44	44	46	43	46	46	54	58	60	62
OASLA*	T	960	960	960	960	960	960	960	960	960	960
H-133 GROUND COMMUNICATION UNIT	T	54	54	55	54	55	56	62	66	68	68
OASLA*	T	960	960	960	960	960	960	960	960	960	960
COMMUNICATION PREFERENCE SPEECH INTERFERENCE LEVEL (PSIL IN DB)	77	77	79	76	79	78	87	90	92	93	87
PSIL											85
ANNOYANCE PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDdB)											
TONE CORRECTION (C IN DB)											
PNLT	95	95	97	94	98	96	105	108	111	112	111
C	2	1	2	1	2	1	2	3	3	3	2

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE I MEASURES OF HUMAN NOISE EXPOSURE
3

NOISE SOURCE/SUBJECT*		OPERATION*		IDENTIFICATION*	
HCU-13/M HEATER-EXPLOSION PROOF, DUCT TYPE PORTABLE		3500 RPM		OMEGA 3.2 TEST 71-020-370	
NEAR FIELD NOISE LEVELS (INSIDE HANGER)		RUN 03		20 AUG 74	
		PAGE H3			
DISTANCE (M)--> 2	2	2	2	2	2
ANGLE (DEG)--> 160	180	200	220	240	260
				300	320
				340	340
				TEST CONDITION	1/A
HAZARD/PROTECTION					
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN OBC) AT EAR					
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR					
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)					
NO PROTECTION					
OASLC	93	94	93	89	88
OASLA	91	91	90	84	82
T	143	143	170	480	571
MINIMUM QPL EAR MUFFS	68	69	68	66	65
OASLA*	960	960	960	960	960
T	AMERICAN OPTICAL 1700 EAR MUFFS	63	63	61	61
OASLA*	T	960	960	960	960
V-51R EAR PLUGS	68	68	67	60	59
OASLA*	T	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS	53	53	53	47	46
OASLA*	T	960	960	960	960
H-133 GROUND COMMUNICATION UNIT	61	61	60	57	56
OASLA*	T	960	960	960	960
COMMUNICATION PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)	85	85	84	78	78
PSIL				77	77
ANNOYANCE				79	79
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)				82	82
TONE CORRECTION (C IN DB)					
PNLT	104	104	103	97	96
C	3	2	2	2	1
				0	1
				1	2
				2	2
					3
					111

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.